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Incidence of Molds on Pecan Nuts at Different Points During Harvesting

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Pecan nuts were selected at various points during routine harvesting, and nutmeats were analyzed for gross and internal fungal contamination and for the presence of *Aspergillus flavus* and *A. parasiticus*. Fungi were isolated from a large percentage of the nutmeats at all points of examination. No correlations could be made between increased incidence of fungi and particular harvesting procedures.

Aflatoxins are secondary metabolites produced by certain strains of *Aspergillus flavus* and *A. parasiticus* on a variety of agricultural commodities. The highly carcinogenic nature of aflatoxin requires that constant monitoring be made for its presence in marketed products to minimize public health hazards. Although data have been reported concerning aspects of mold growth and toxin contamination during pecan (*Carya illioensis* [Wangenh.] K. Koch) production (J. Taylor and R. E. Worley, Proc. Southeastern Pecan Growers Assoc., p. 29, 1972), as pecans enter the shelling plant (4), and during storage (3; E. K. Heaton, Proc. Southeastern Pecan Growers Assoc., p. 135, 1972), no information is available describing the incidence of molds in general and potential aflatoxin-producing molds in particular on nutmeats as pecan nuts are sequentially subjected to various mechanical harvesting procedures. Substantial physical damage and exposure to field dirt may occur when nuts are mechanically shaken from the tree, swept in windrows, transported to shelling plants, and cleaned in preparation for cold storage. It has been suggested that increased levels of molds on nutmeats as they enter the processing plant may be a result of a specific mishandling procedure at some point during the harvesting scheme. Knowledge of increased contamination by *A. flavus* or *A. parasiticus* at a point(s) during traditional harvesting procedures might enable modifications to be made which would ultimately reduce the potential for aflatoxin contamination.

With this in mind, 'Stuart,' a thick-shelled pecan cultivar, and 'Schley,' a thin-shelled cultivar, were mechanically harvested or hand selected on 23 to 26 October 1974 from groves near Albany, Ga. Points of examination are listed in Table 1. Samples were subdivided in the laboratory, and individual pecans were aseptically cracked. One-half (or a piece) of the kernel from each nut was plated on malt extract agar. The remaining half (piece) was surface sterilized (1, 4) by dipping for 2 min into a solution containing 20% commercial bleach (6% sodium hypochlorite as the active ingredient), 20% ethanol, and 60% water before plating on malt extract agar. All plates were incubated at room temperature (22 to 24 C) for up to 3 weeks, after which the number of pecan halves (pieces) showing fungal growth was recorded. Any colony suspected of belonging to the *A. flavus-oryzae* group was subcultured on a second malt extract agar plate. Morphological characteristics were observed during growth and identification of *A. flavus* and *A. parasiticus* was made according to the classification given by Raper and Fennell (9). Data were analyzed by using the chi-square criterion.

Results of visual inspection of pecan nutmeats at the time they were taken from the shell and the incidence of total molds as well as *A. flavus* and *A. parasiticus* on the nutmeats are summarized in Table 1. Any portion of the nutmeat of a single nut judged as inedible constituted a positive rejection. Criteria for inedibility included visual mold or insect damage, discoloration, and marked shriveling. The percentage of nutmeats judged as inedible increased in samples at collection points in the sequence after pecans were mechanically swept in windrows. Surprisingly low levels of inedibles were noted in uncracked "blow-outs," a term applied to low-specific-weight nuts which are separated from sound nuts by a high-velocity air stream prior to storage. Nutmeats are generally shrunken or unfavorably developed. Al-

TABLE 1. *Incidence of mold on pecan nutmeats at various points during pecan harvesting*[a]

Cultivar	Point of examination	Inedible[b]	Mold incidence[c]		*A. flavus* (*parasiticus*)[d]	
			Gross	Internal	Gross	Internal
Schley	Tree, hand picked	1/100h	94/96abc	82/96a	1/96	0/96
Stuart	Tree, hand picked	0/53	49/50ab	32/53bcd	1/50	0/53
Schley	Ground, before shaking	7/100efg	98/100ab	61/100bcd	2/100	0/100
Schley	Ground, after shaking	1/100h	98/99a	59/100bcd	2/99	1/100
Stuart	Ground, after shaking	1/100h	92/100bcd	54/100cde	1/100	0/100
Schley	Windrow, after shaking	3/100gh	96/100abc	71/100b	0/100	0/100
Schley	Windrow, after sweeping	7/100efg	89/96bcd	62/96bc	2/96	0/96
Stuart	Windrow, after sweeping	16/100cd	83/95de	59/99bcd	0/95	0/99
Schley	Hopper, in grove	14/100cde	85/92bcd	34/92fgh	0/92	0/92
Stuart	Hopper, in grove	9/100def	91/100cd	39/100fgh	1/100	0/100
Stuart	Wagon, in grove	28/100b	94/96ab	58/92bcd	0/96	0/92
Schley	Wagon, at plant before drying	7/100efg	93/100bcd	40/96efg	1/100	1/96
Stuart	Wagon, at plant before drying	7/100efg	87/93bcd	43/88def	0/93	0/88
Stuart	Cleaner, after cleaning	16/100cd	87/96cde	28/96ghi	0/96	1/96
Schley	Drying bin	21/100bc	85/100de	27/100hi	1/100	0/100
Schley	Bin, just before storage	5/100fgh	78/96e	69/96b	1/96	2/96
Stuart	Bin, just before storage	12/100cdef	87/100de	22/96i	2/100	0/96
Schley	Blow-out, culls	18/100bcd	99/100a	83/96a	1/100	0/96
Stuart	Blow-out, culls	15/100cde	89/95bcd	62/99bcd	2/95	0/99
Schley	Cracked blow-out, culls	74/81a	71/78cde	22/73ghi	1/78	0/73

[a] Values in the same column bearing the same letter are not significantly different ($P < 0.05$). Complete absence of letter designation indicates that none of the values in a particular column was significantly different ($P < 0.05$) or that no statistical basis exists for detecting differences between samples, since at least one member of any possible pair showed no positive reaction.

[b] Number of whole nuts containing inedible portion (first number) per number of whole nuts examined (second number).

[c] Number of mold-contaminated halves and pieces (first number) per number of halves and pieces examined (second number).

[d] Number of *A. flavus*- and *A. parasiticus*-contaminated halves and pieces (first number) per number of halves and pieces examined (second number).

though nutmeats of blow-outs were somewhat dehydrated, most were still judged as edible.

Data show that pecan kernels are highly contaminated with molds while on the tree, the initial point of examination in this study. This observation was also reported by Hanlin (5), who noted that no fungi were present in pecan embryos but, as the seeds ripened, the level of fungi approached 100% at maturity. Substantial levels of internal fungal contamination of nutmeats were found in the present study, regardless of the sampling point in the harvesting scheme. Although significantly higher levels of gross and internal mold contamination were noted at points in the harvesting scheme, these levels were not noted exclusively or predominantly after a particular handling procedure. Therefore, neither gross nor internal build-up of mold levels can be correlated with a particular procedure used during pecan harvesting and handling. Furthermore, contamination does not appear to be associated with subjective judgments regarding inedibility.

Table 1 also lists information on the incidence of *A. flavus* plus *A. parasiticus* on and in pecan kernels. Although these values are somewhat less than those reported for stored pecan halves (1) and bakery pecans (8), they are in line with recent data reported by Escher et al. (4) on sound and blow-out nuts as delivered to the shelling plant. On the other hand, Chipley and Heaton (2) found no *A. flavus* or *A. parasiticus* on small samples of aseptically shelled pecan meats. Differences in the populations of aspergilli and other fungi on pecans apparently are due to relative levels of particular genera at particular geographical locations as well as to climatic and storage conditions to which the pecans are exposed prior to examination. Reports have shown considerable variation in the distribution of fungal genera throughout the Southeast (6, 7). As in the case of total mold incidence, levels of *A. flavus* and *A. parasiticus* do not appear to be associated with a particular harvesting procedure or with a particular cultivar. Substantially higher levels were not noted to consistently occur in blow-outs.

Data presented here are preliminary in nature and should be substantiated by repetitive examination of pecan nuts from several groves over a period of years. Nevertheless, observations from this study tend to disprove the theory that a particular mechanical harvesting practice might cause increased levels of mold contamination on pecan nutmeats. Alternative approaches may be necessary to control the incidence of potential toxin-producing molds on pecan nuts.

LITERATURE CITED

1. Blanchard, R. O., and R. T. Hanlin. 1973. Effect of propylene oxide treatment on the microflora of pecans. Appl. Microbiol. **26**:768–772.
2. Chipley, J. R., and E. K. Heaton. 1971. Microbial flora of pecan meat. Appl. Microbiol. **22**:252–253.
3. Doupnik, B., Jr., and D. K. Bell. 1971. Toxicity of chicks of *Aspergillus* and *Penicillium* species isolated from moldy pecans. Appl. Microbiol. **21**:1104–1106.
4. Escher, F. E., P. E. Koehler, and J. C. Ayres. 1974. A study on aflatoxin and mold contaminations in improved variety pecans. J. Food Sci. **39**:1127–1129.
5. Hanlin, R. T. 1971. Fungi isolated from young pecans. Proc. Ga. Pecan Growers Assoc. **2**:20–26.
6. Hanlin, R. T. 1973. The distribution of peanut fungi in the southeastern United States. Mycopathol. Mycol. Appl. **49**:227–241.
7. Jackson, C. R. 1968. A field study of fungal associations on peanut fruit. Univ. Ga. Col. Agric. Exp. Stn. Res. Bull. **26**:1–29.
8. Lillard, H. S., R. T. Hanlin, and D. A. Lillard. 1970. Aflatoxigenic isolates of *Aspergillus flavus* from pecans. Appl. Microbiol. **19**:128–130.
9. Raper, K. B., and D. I. Fennell. 1965. The genus *Aspergillus*. The Williams & Wilkins Co., Baltimore.